



SAR Data Cubes: Prozessierung und Datenmanagement mit pyroSAR

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Data retrieval pipelines

Sentinel-1 Data providers

- Copernicus Open Access Hub
- ASF Vertex
- Amazon Web Services
- ...



Cloud Infrastructure

- DIAS
- CODE-DE
- Amazon Web Services
- ...



Analysis Ready Data providers

- Google Earth Engine
- Sinergise EO Browser
- ...



Local server infrastructure



Pre-Processing

- GAMMA
- SNAP
- ...

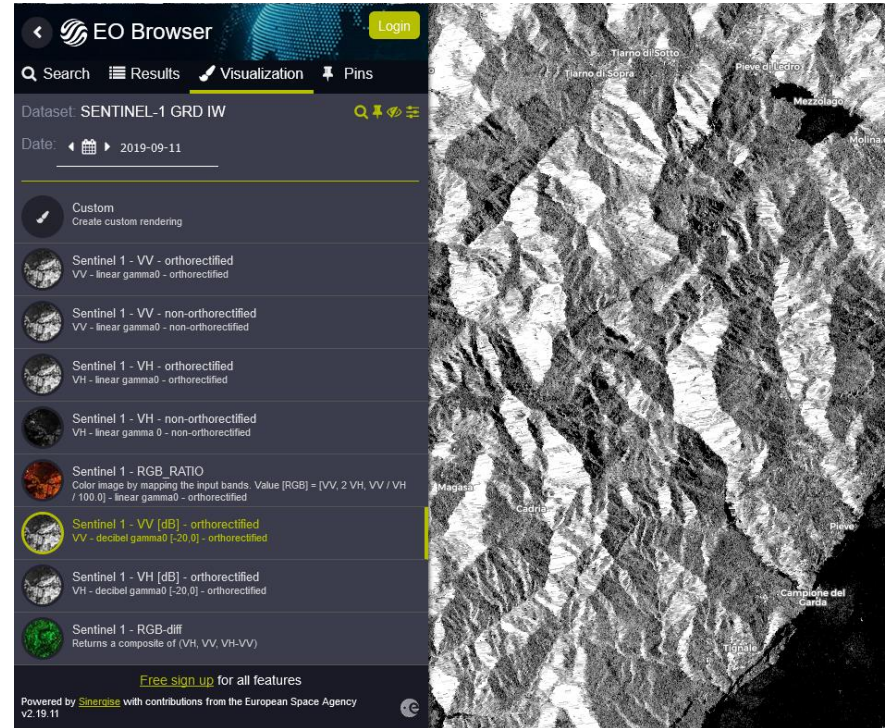
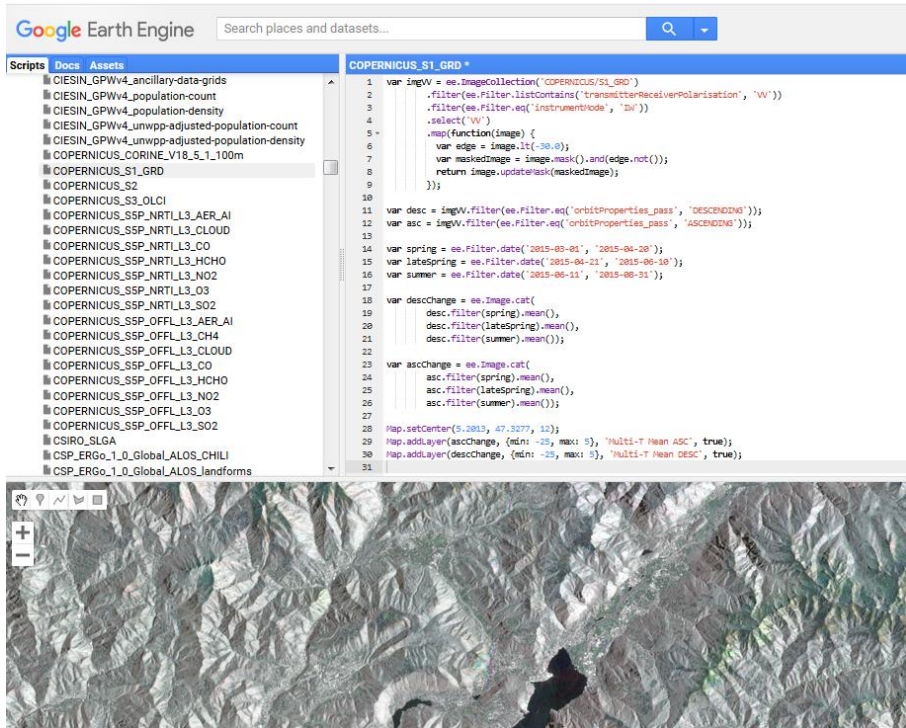


Data Cube Analysis

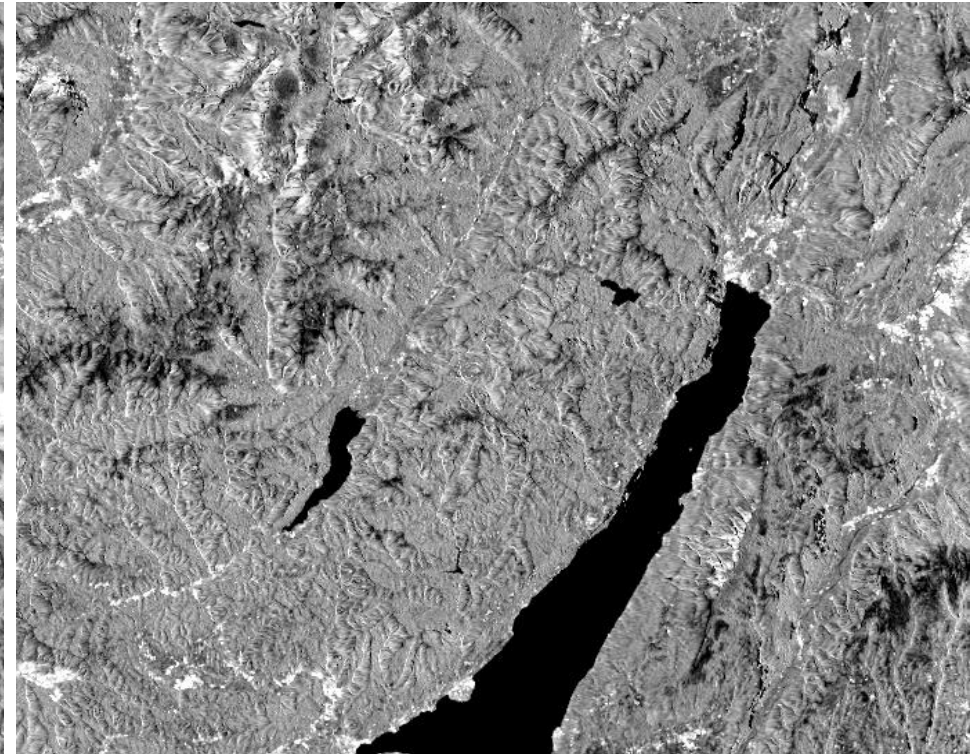
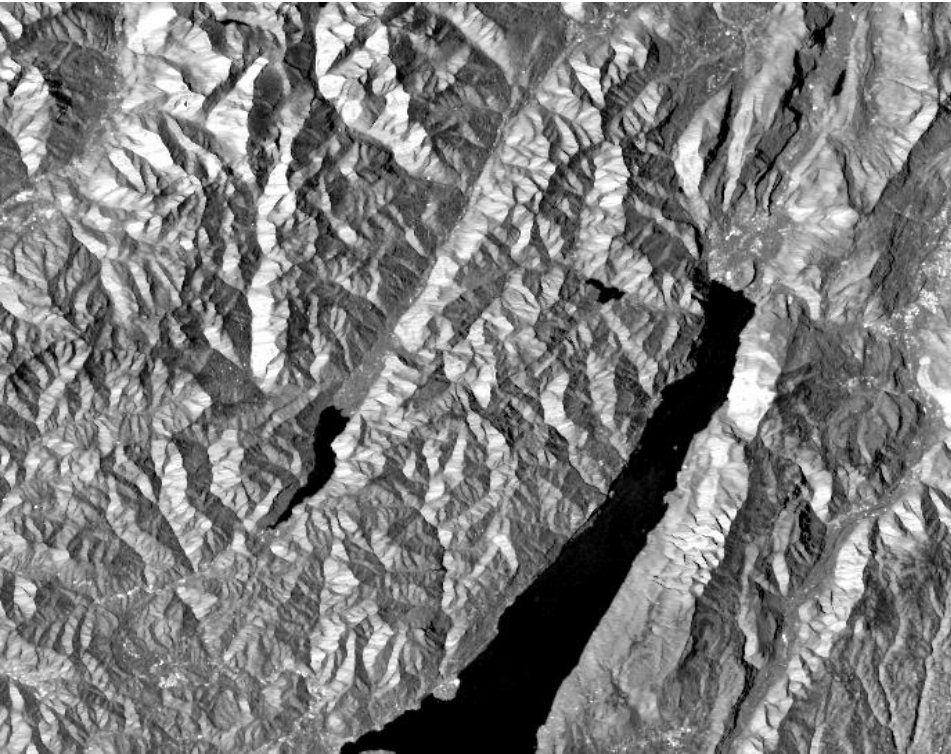
- ODC
- ESDL
- GEE
- ...



SAR Analysis Ready Data on the Web



SAR RTC: Radiometric Terrain Correction



Garda Lake, Italy: Sentinel-1 GRD image acquired on Aug. 28 2018; (left) without terrain flattening, (right) with terrain flattening



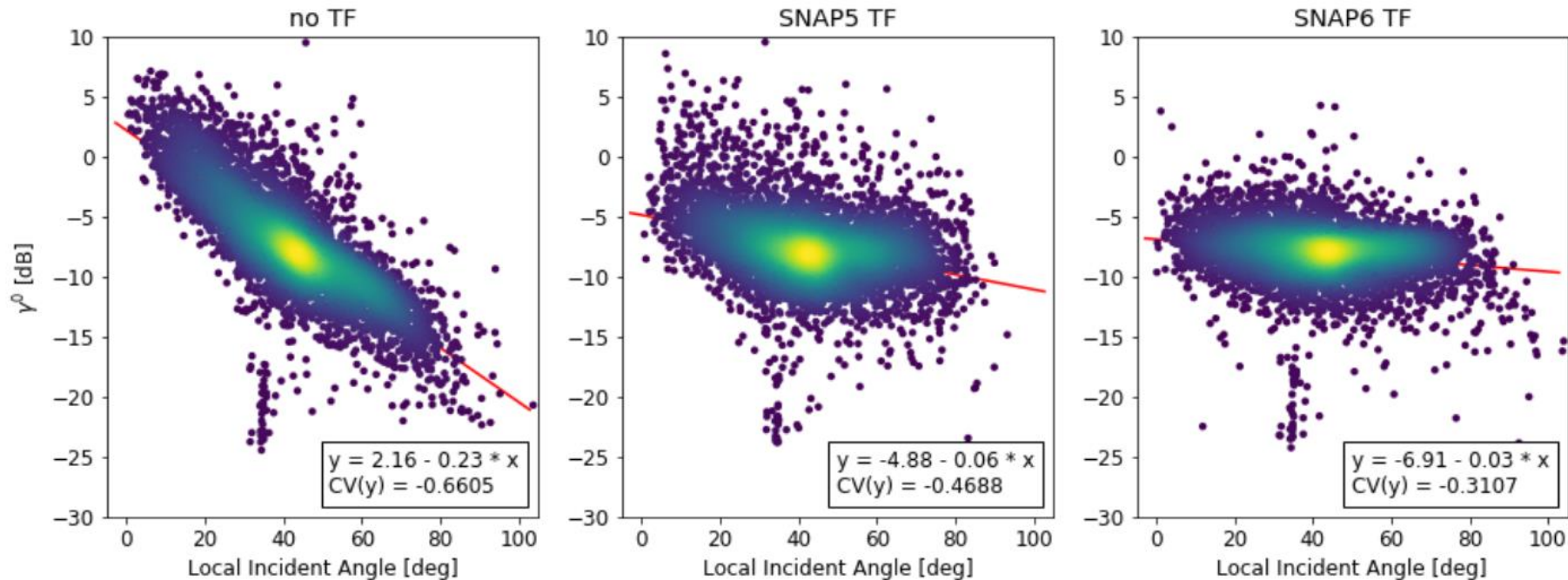
Article

Towards Sentinel-1 SAR Analysis-Ready Data: A Best Practices Assessment on Preparing Backscatter Data for the Cube

John Truckenbrodt ^{1,2,*} , Terri Freemantle ³ , Chris Williams ³, Tom Jones ³, David Small ⁴ ,
Clémence Dubois ¹, Christian Thiel ², Cristian Rossi ³, Asimina Syriou ³ and Gregory Giuliani ⁵ 

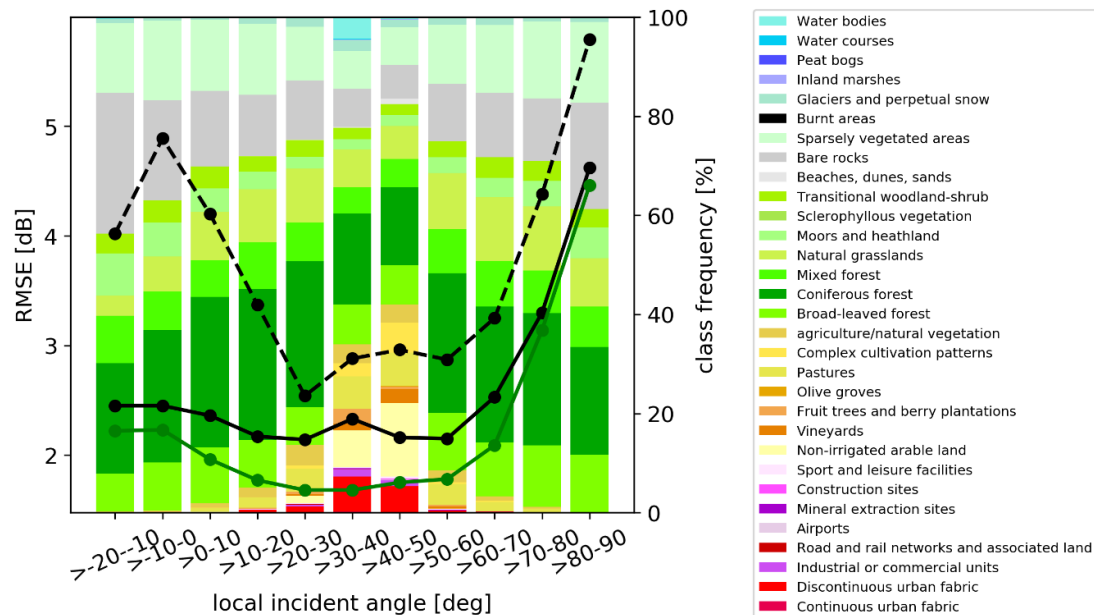
Data **2019**, *4*, 93; doi:10.3390/data4030093

comparison of processors: software versions



Comparison of SNAP RTC processing results without terrain flattening (TF) and with the implementations of SNAP5 and SNAP6

comparison of processors: SNAP vs. GAMMA



Comparison of SNAP vs. GAMMA processing results. RMSE in dependence of local incident angle and land cover class. Solid black and green lines: SNAP6 vs. GAMMA for all classes (black) and for forest (green). Dashed black line: result for all classes using SNAP5

Data retrieval pipelines

SAR Data providers

- Copernicus Open Access Hub
- ASF Vertex
- Amazon Web Services
- ...



For each available scene

- Download a copy to the local server
- Read its metadata
- Store the metadata in a database



ALPSRP224031000-H1.1__A
ALOS2048992750-150420-FBDR1.5RUD
S1A_IW_GRDH_1SDV_...zip
...



For each test site

- Select all overlapping scenes from the database
- Process all scenes to the extent of the test site
- Index/ingest all products in a data cube

Local server
infrastructure



Pre-Processing

- GAMMA
- SNAP
- ...



Data Cube Analysis

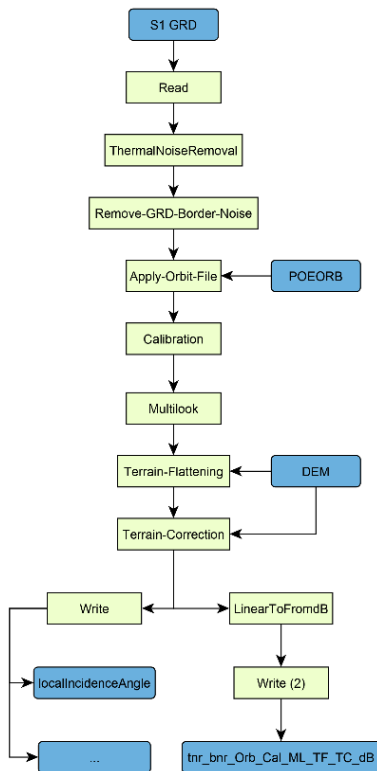
- ODC
- ESDL
- ...



SAR Processing

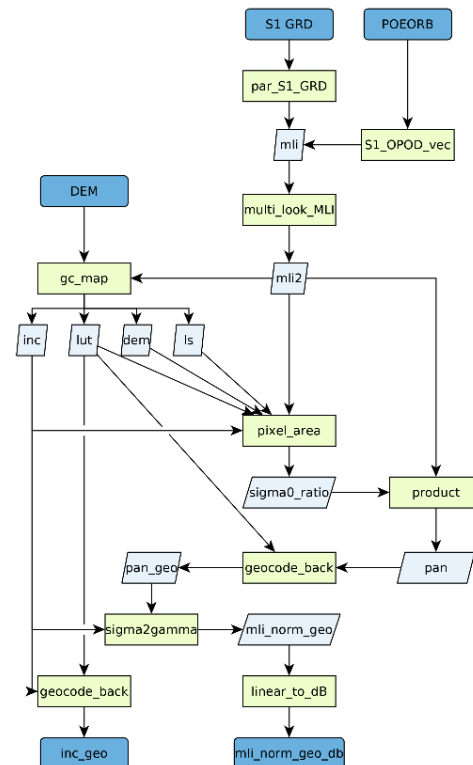
SNAP

- XML workflows
- Graphical User Interface
- Convenient data handling and automation
- Very easy to get started with, yet still powerful



GAMMA

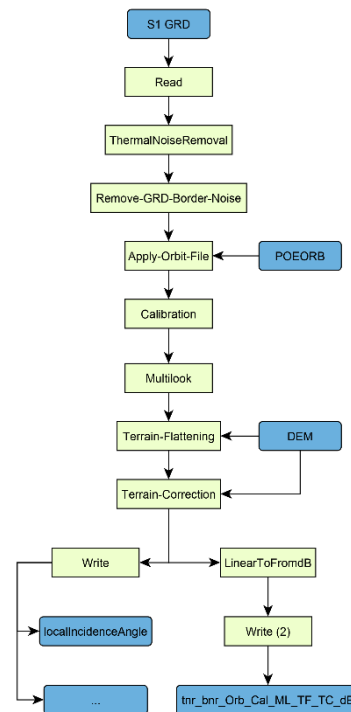
- Command line interface
- Manual data handling
- Requires more knowledge about SAR processing theory
- Very powerful
- better control over parametrization
- Very reliable



SAR Processing

SNAP in pyroSAR








- Parsing of custom workflows in Python depending on user input
- Execution of workflow XML files using SNAP's graph processing tool (GPT)
- Splitting of workflows into smaller groups for increased speed (up to 7x observed)
- Automated download of OSV and DEM files prior to processing (SNAP currently ignores proxy settings)
- Use SNAP in Python with increased speed and usability










Traceability and Reproducibility

basename	sensor	acquisition_mode	orbit	start	polarization	product
S1A_IW__A_20141022T164518_VV_grd	S1A	IW	A	20141022T164518	VV	grd
ASAR_APP__D_20050123T092033_VV_pri	ASAR	APP	D	20050123T092033	VV	pri

SNAP

 S1A_IW__A_20180829T170656_dem.tif
 S1A_IW__A_20180829T170656_incidenceAngleFromEllipsoid.tif
 S1A_IW__A_20180829T170656_localIncidenceAngle.tif
 S1A_IW__A_20180829T170656_projectedLocalIncidenceAngle.tif
 S1A_IW__A_20180829T170656_tnr_bnr_Orb_Cal_ML_TF_TC_dB_proc.xml
 S1A_IW__A_20180829T170656_VH_tnr_bnr_Orb_Cal_ML_TF_TC_dB.tif
 S1A_IW__A_20180829T170656_VV_tnr_bnr_Orb_Cal_ML_TF_TC_dB.tif

GAMMA

 S1A_IW__A_20180829T170656_commands.sh
 S1A_IW__A_20180829T170656_dem_seg_geo.tif
 S1A_IW__A_20180829T170656_inc_geo.tif
 S1A_IW__A_20180829T170656_ls_map_geo.tif
 S1A_IW__A_20180829T170656_manifest.safe
 S1A_IW__A_20180829T170656_VH_grd_mli_norm_geo_db.tif
 S1A_IW__A_20180829T170656_VV_grd_mli_norm_geo_db.tif

Ingestion example: Open Data Cube

S1A_IW__A_20180829T170656_commands.sh
S1A_IW__A_20180829T170656_dem_seg_geo.tif
S1A_IW__A_20180829T170656_inc_geo.tif
S1A_IW__A_20180829T170656_ls_map_geo.tif
S1A_IW__A_20180829T170656_manifest.safe
S1A_IW__A_20180829T170656_VH_grd_mli_norm_geo_db.tif
S1A_IW__A_20180829T170656_VV_grd_mli_norm_geo_db.tif



description: Gamma Naught RTC backscatter
measurements:
- dtype: float32
 name: VH
 nodata: -99.0
 units: backscatter VH
- dtype: float32
 name: VV
 nodata: -99.0
 units: backscatter VV
metadata:
 format:
 name: GTiff
 instrument:
 name: C-SAR
 platform:
 code: SENTINEL-1
 product_type: gamma0
 metadata_type: eo
 name: S1_GRD_index



Generalization of metadata to

- Create common ODC product description
- Create ODC files for indexing images with the product and ingesting them into the ODC file system

ODC or ESDL or...?

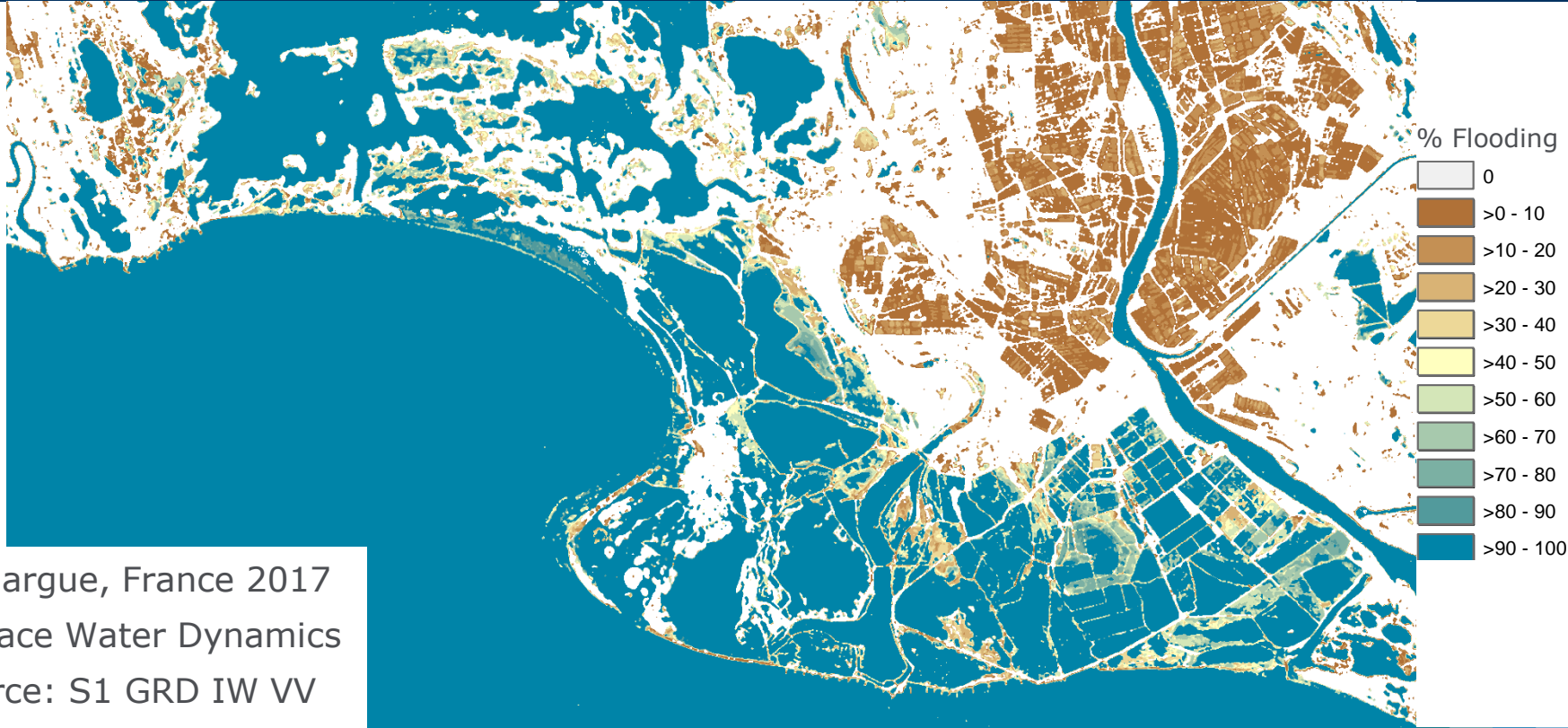


EARTH
SYSTEM
DATA
LAB

Session 5b



Use Case: Wetland Monitoring



pyroSAR on the Web

<https://github.com/johntruckenbrodt/pyroSAR>

<https://pyrosar.readthedocs.io/en/latest/>



pyroSAR
latest

Search docs

Installation
File Naming
Handling of Orbit State Vector Files
DEM Preparation
SAR Image Handling and Processing
Drivers
SNAP Processing
GAMMA Processing

Docs » Welcome to pyroSAR's documentation! [Edit on GitHub](#)

Welcome to pyroSAR's documentation!

General Topics

- [Installation](#)
- [File Naming](#)
- [Handling of Orbit State Vector Files](#)
- [DEM Preparation](#)
- [SAR Image Handling and Processing](#)

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Vielen Dank
für Ihre Aufmerksamkeit!

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<https://github.com/johntruckenbrodt>



Camargue, France:
Sentinel-1 GRD VV
Backscatter 2017

